METRICATION

a guide for producers of packaged goods...

SECOND EDITION

Cat. No.: RG31-4/1973

METRICATION
a guide for producers of packaged goods

CONSUMER RESEARCH REPORT No.4 SECOND EDITION

Published by authority of the Honourable Herb Gray,
Minister of Consumer and Corporate Affairs.

Metrication is a word that has been coined to describe the process of changing from the traditional system of weights and measures to one based on the metric system. The use of metric units for trade has been legal in Canada since before 1900, but it has only recently begun to be adopted extensively as a form of quantity marking. Most people are not aware that all existing Canadian units are based on metric standards and, in particular, on the units of the Système International (SI); this is explicitly stated in Section 4 of the Weights and Measures Act. The SI is a "coherent" metric system: that is, one that minimizes the number of conversion factors. For most practical purposes it is identical with the metric system that has been taught in schools for many years and was used every day by many European immigrants before they came to Canada. The differences occur mostly in scientific and technical measurements.

The instinctive reaction of most people to metrication is one of anxiety. What's wrong with the present system? Won't it cost a lot of money? Why bother? The answers to these questions were set out in a federal White Paper on Metric Conversion in Canada published in January, 1970. Quite simply, the world is moving towards a single system of units (the metric system) and for Canada to be the "odd man out" is just not possible without hurting our trade. The United States Metric Study, undertaken by the National Bureau of Standards in accordance with legislation passed by the Congress, recommends that the United States change to the international metric system and that the Congress, after deciding upon a plan for the nation, establish a target date ten years ahead.

The adoption of the metric system will undoubtedly bring benefits in the future to industry and the consumer. The intention of this booklet is to expose these benefits and also to try to remove the anxieties. It is not intended to be a definitive statement of the regulations of the Consumer Packaging and Labelling Act, the Weights and Measures Act or other relevant acts.

In the last twenty years there has been a continuing trend towards improved communications and greater world trade. (Canada's exports increased from $3.9 billion in 1950 to $17 billion in 1970; for every passenger who travelled by air in 1950 there are ten now). Along with this there has been a desire for world uniformity in standards to make life easier both for the consumer and the producer. An inhibiting factor has been the different systems of units used in different parts of the world. India was the first country in recent times to change its customary units to metric. It changed in 1959 and since then Japan and most of the Commonwealth have moved towards the adoption of metric units. The change in Britain is planned to be completed in 1975 and after that the United States and Canada will be

the only industrialized countries using the old system of inches, pounds and quarts. Canada's plans for the changeover have not yet included a completion date, but it is an undisputed fact in those countries that have made the change, that the manufacturers and distributors who planned ahead reaped the greatest benefits. The publication of the White Paper was the government's first step. This has been followed by the Weights and Measures Act, which stated the metric units to be used, and the Consumer Packaging and Labelling Act, which made quantity marking in metric units mandatory. The Metric Commission has been set up and will shortly start its work of advice to industry and the co-ordination of planning. The general public will gradually become accustomed to metric units through dual labelling and it is likely that public education will be subconscious rather than obvious. Learning a different system of units is like learning a new language — if you don't practice it, the knowledge soon fades away. Hence, there is little value in massive publicity in advance of the adoption of metric units by a wide cross-section of industry.

In a few years, schools will be teaching only the metric system to the lower grades and these children will be among the first Canadians really to benefit from metrication. They will not have to learn the complicated conversion factors of 12 inches to the foot, 16 ounces to the pound, 20 fluid ounces to the pint with which we have become familiar, and they should find mathematics that much easier — even enjoyable.

Confusing examples

Here are some examples of confusing weights and measures that will disappear once the metric system is completely adopted in Canada:

- A gallon (US) and a gallon (Canadian) — the US gallon is about 5/6 of a Canadian gallon.
- A pint and a "pinte" — the latter is the French word for quart.
- A US quart (liquid) and a US quart, (dry measure) — the former is 946.3 ml and the latter 1101.2 ml. Quarts both liquid and dry, are 1136.5 ml in Canada.
- Long tons and short tons — the former is 2240 lb, the latter is 2000 lb.
- Troy ounces and avoirdupois ounces; and troy pounds and avoirdupois pounds. At present a pound of feathers weighs more than a pound of gold, but an ounce of feathers weighs less than an ounce of gold. This is because gold is measured by troy weight (1 ounce = 31.10 g, 1 pound = 373.24 g) while feathers are measured by avoirdupois (1 ounce = 28.35 g, 1 pound = 453.59 g). The pound troy is no longer a legal unit in Canada but the term is still occasionally used.
- Ounces and fluid ounces — 1 fluid ounce weighs 1 ounce only when the substance involved has the same density as water.
- Measuring cups — the household measuring cup is, for all practical

purposes, the same size (8 fl oz) in both Canada and the US, but in Canada there are 2.4 cups to the (Canadian) pint while in the US there are 2 cups to the (US) pint.

Wider Implications of Metrication

Metrication does not mean just changing labels. This is merely the first stage — a translation of the present quantity marking to an appropriate metric marking. Conversion is only complete when the packing is done in round metric quantities, for example 125 g, 500 g, 2 kg, 250 ml. In most cases this means changing the package size. Metrication therefore gives every manufacturer of packaged goods an opportunity to re-examine his marketing program in order to give the consumer an ideal range of sizes. The conversion from existing package sizes to round metric ones cannot be instantaneous and may take several years. Nevertheless, if a package size change is contemplated in the near future it might be wise for an industry to consider round metric quantities.

Apart from the separate issue of possible standardization of some packages, which will occur under the Consumer Packaging and Labelling Act, metrication may well bring benefits of standardization or rationalization to manufacturers. This has certainly happened in other countries which have changed, and is part of the general re-examination of existing quantities of sale mentioned in the previous paragraph. In some recorded cases, inventories have been reduced by 50 per cent after full metrication. Such standardization of supplies could be achieved with existing units, but metrication provides an incentive.

There are a number of other advantages to working in a system of units where all the conversion factors are multiples of ten. The simplicity of the metric system is obvious from the tables below:

1000 mils	= 1 inch
12 inches	= 1 foot
3 feet	= 1 yard

10 millimetres	= 1 centimetre
100 centimetres	= 1 metre
1000 metres	= 1 kilometre

Similar tables could be drawn up for mass (weight) and capacity — the former would include 437½ grains = 1 ounce. Clearly the number of errors involving conversion from one unit to another will be greatly reduced with the metric system, although it is possible that some may arise with the increased use of decimals. However, a misplaced decimal point *should* be obvious in most cases from the context in which the figures appear. There have been examples quoted of fatal doses of drugs being prescribed, which have been blamed on misplaced decimal points, but most of these occurred because the unit was not precisely stated. Occasionally, milligrams were assumed where micrograms

would have been correct, or the figures were incorrectly written. For example, to avoid any confusion between ".05 mg" and 0.5 mg it would be far better to show the former amount as 50 micrograms.

From a production point of view changes in formulation are made easier by the use of metric units. Percentage increases or reductions of ingredients in a product recipe can be calculated with greater speed and accuracy if the units in which they are measured are in multiples of ten. Several Canadian firms whose products are of this type already use the metric system for operations within their organization, although the product is labelled in traditional units for the final consumer.

The Consumer Packaging and Labelling Act

Bill C-180 became the Consumer Packaging and Labelling Act and received Royal Assent on June 10, 1971. Much of the Act is general and will only become specific when regulations are published sometime in 1972. Section 4(1) states that all prepackaged products must be marked with a declaration of net quantity in either (a) numerical count or (b) a metric unit of measurement set out in Schedule I of the Weights and Measures Act *and* a Canadian unit of measurement set out in Schedule II of that Act. In practice the regulations are likely to be phrased so that the declaration is either in both systems or in metric units alone. Section 4(2) goes on to say that this declaration must be on the principal display panel; must be clearly and prominently displayed; must be easily legible; and must be in distinct contrast to any other information or representation shown on the label. The Act applies to imports as well as to home-produced products, and also to any advertisements which contain a statement of net quantity although dual labelling will not be required on advertisements. Any statement on the label which refers to the number of servings contained in the package must state the net quantity of each serving either in numerical count or in metric units or in traditional *and* metric units.

To the vast majority of manufacturers and packers the new regulations will mean at the very least a change of label. They may well cause design departments some problems in fitting all the figures and units in. The type size must be the same for both metric and Canadian units and the two statements of net contents must be together on the label.

Another section of the Act that is of some interest to manufacturers is Section 11 dealing with the standardization of containers where there is undue proliferation of sizes or shapes likely to confuse or mislead consumers as to the weight, measure or numerical count of the prepackaged product. Regulations dealing with products coming into this category are being drafted and it is possible that many of the stan-

dardized quantities will be in round metric units. It is intended that other acts, such as the Food and Drugs Act, which have regulations similar to those to be drafted under the Consumer Packaging and Labelling Act, will be brought into line with the latter act as soon as possible so that packaging requirements will be as uniform as possible.

Some recommendations for dual marking and for possible round metric quantities are made later in this booklet.

Metric Units

A summary of Schedule I of the Weights and Measures Act is reproduced below and gives the more important metric units and their symbols. All these symbols are written without periods.

Basic Units

metre	m	— unit of length
kilogram	kg	— unit of mass
second	s	— unit of time
ampere	A	— unit of electric current

Derived Units

newton	N	— unit of force
joule	J	— unit of work
watt	W	— unit of power
hertz	Hz	— unit of frequency

Customary Units

minute	min	— 60 seconds
hour	h	— 60 minutes
litre	ℓ	— 1/1000 cubic metre
metric ton	t	— 1000 kilograms

Prefixes for Multiple and Submultiples

tera	T	— 10^{12}
giga	G	— 10^{9}
mega	M	— 10^{6}
kilo	k	— 10^{3}
hecto	h	— 10^{2}
deca	da	— 10^{1}
deci	d	— 10^{-1}
centi	c	— 10^{-2}
milli	m	— 10^{-3}
micro	μ	— 10^{-6}
nano	n	— 10^{-9}
pico	p	— 10^{-12}
femto	f	— 10^{-15}
atto	a	— 10^{-18}

The most frequently used units in the consumer field are likely to be: grams (g) and kilograms (kg); millimetres (mm), centimetres (cm) and metres (m); millilitres (ml) and litres. Many of the prefixes are only rarely used and it is advisable to stick to the basic units or the prefixes mega, kilo, and milli. The chief exception to this is likely to be the centimetre, which will be the most usual unit for measuring clothes sizes and also, possibly, for some hardware items. The usual cubic measures will be cubic centimetres, cubic decimetres, and cubic metres. The correct symbols for these are cm^3, dm^3 and m^3. Tradition may, however, lead to continued use in some cases of the abbreviations cc, cu dm, and cu m until consumers get used to the correct symbols. In many cases, either a weight marking in grams or kilograms, or a capacity measurement in millilitres or litres

would be preferable.

The symbol for litres may also cause some confusion as the letter l on many typewriters and in some print styles is identical with the figure 1. If the units follow the figures without a space, "14l" could mean 14 litres, or the number 141. It may often be preferable to write the word litres in full. A possible alternative is to write it as 14000 ml but this is not recommended.

Basic rules for writing metric quantities

The majority of metric symbols that will be used on packages should be written in lower case. The only exceptions are those of units named after historic persons. Examples:

Unit	Symbol
metre	m
gram	g
watt	W
volt	V
degree Celsius	°C

When written out, only "Celsius" is capitalized; all other terms have lower case initial letters. The degree symbol (°) is used with Celsius to distinguish it from C, which is the symbol for the unit of electrical quantity, the coulomb. The Celsius scale of temperature was formerly known as the Centigrade scale.

The plural -s is *never* used with metric symbols, and correct metric symbols are written without a period.

Examples:

Correct*	Wrong
500 g	500 gr
250 ml	250 ml.
24 mm	24 mms

As mentioned previously, the abbreviations for square and cubic measures present some difficulty.

Examples:

Correct*	Acceptable
25 cm^3	25 cc
450 m^2	450 sq m

The preposition "per" is replaced by a diagonal stroke.
Example: kilometres per hour is written km/h.

Only one prefix can be used at a time.
Example: 7 centi-decimetres is written as 7 millimetres (or 7 mm).

As far as possible units should be chosen so that whole numbers in the range 1 to 1000 are used.
Example: 11000 g is better written as 11 kg.

There may be occasions when it is necessary to use numbers smaller than 1. In these cases a decimal point should be used — avoid fractions whenever possible.
Example: 55 mm may be written as 5.5 cm or even 0.055 m but not 5½ cm.

**As recommended by the International Organization for Standardization.*

A zero must precede the decimal point if the quantity is less than one unit.

Examples:

Correct	Acceptable
500 mg	0.5 g
37.5 cm	0.375 m

Wrong

.5 g or ½ g

.375 m, 3/8 m or 37½ cm

An accuracy of three figures is sufficient for most consumer products and below certain limits the Consumer Packaging and Labelling Regulations are likely to permit an accuracy of only two figures. If four figures are given, this implies measurement more accurate than one part in 1000, which is generally beyond the capability of most packagers.

Examples:

Adequate	Excessive
91.4 cm	91.44 cm (1 yard)
568 ml	568.2 ml (1 pint)

When round metric packages are produced, a similar three-figure accuracy is sufficient for the conversion to traditional units, if such a conversion is to be given.

Examples:

Adequate	Excessive
1.76 pints	1.7598 pints (1 litre)
8.82 oz	8.818 oz (250 g)

The various rules stated above can be summarized for the most usual quantity markings as follows:

Weight

If the product weight is less than 100 g (3.5 oz), express the metric weight in grams to 2 figures.

If the product weight is between 100 g and 1 kg (2.20 lb) express the metric weight in grams to 3 figures.

If the product weight is greater than 1 kg, express the metric weight in kilograms to 3 figures.

Length

If the product length is less than 100 cm (39.4 in) express the metric length in centimetres to 2 figures.

If the product length is greater than 1 m, express the metric length in metres to 3 figures.

Area

If the product area is less than 100 cm^2 (15.5 sq in) express the metric area in square centimetres to 2 figures.

If the product area is between 100 cm^2 and 1 m^2 (10.8 sq ft) express the metric area in square centimetres to 3 figures.

If the product area is greater than 1 m^2, express the metric area in square metres to 3 figures.

Volume/capacity of liquid or viscous products

If the product capacity is less than 100 ml (3.5 fl oz) express the metric capacity in millilitres to 2 figures.

If the product capacity is between 100 ml and 1 litre (1.76 pints), express the metric capacity in millilitres to 3 figures.

If the product capacity is more than 1 litre, express the metric capacity in litres to 3 figures.

Volume of solids

If the product volume is less than 100 cm^3 (6.1 cu in) express the metric volume in cubic centimetres to 2 figures.

If the product volume is between 100 cm^3 and 1 dm^3 (61.0 cu in) express the metric volume in cubic centimetres to 3 figures.

If the product volume is between 1 dm^3 and 1 m^3 (35.3 cu ft) express the metric volume in cubic decimetres to 3 figures.

If the product volume is greater than 1 m^3, express the metric volume in cubic metres to 3 figures.

Dual labelling before metrication

The Consumer Packaging and Labelling Act requires a metric conversion to be shown if a package is labelled in traditional units. This is known as dual labelling and is done in order to get the consumer accustomed to the magnitude of the metric units. However, much of the educational value of dual labelling will be lost if it is done in a haphazard and non-uniform manner. For example, a housewife who sees three packages on a supermarket shelf labelled 1 lb (450 g), 1 lb (453.6 g) and 1 lb (454 g) is immediately going to be skeptical about the simplicity of the metric system. She is going to say how can 1 lb be three different weights? When a product is marked with both a metric and a traditional quantity marking the net quantity of the product must be not less than the greater of the two. Prescribed deficiency tolerances will be defined in regulations in the near future.

However, the rounding of metric conversions should be done by the usual mathematical convention. In most practical metric conversions this means that when the next figure beyond those required is five or more, round upwards; and when the next figure beyond those required is four or less, round downwards. For example:

One pound is 453.592 g to three decimal places. Rounding to 454 g would give a three figure accuracy.

One quart is 1.1365 litres to four decimal places. Rounding to 1.14 litres would give a three figure accuracy.

If the next figure beyond those required is not only a five but also the final figure shown, then a greater degree of accuracy must be achieved before rounding. For example:

One foot is 30.5 cm to one decimal

place. An accuracy of two figures cannot be determined from this statement. However, one foot is exactly 30.48 cm and so rounding to 30 cm would give a two figure accuracy.

In some rare cases the next figure beyond those required may be *exactly* five followed only by zero, when the convention is to round to an even number. The only likely practical situation when the rules given above would not apply is when converting 75 in to cm. The *exact* equivalent of 75 in is 190.5 cm and this would be rounded to 190 cm for a three figure accuracy. These rules are significantly different from those stated in an earlier edition of this booklet.

The following examples illustrate some conversions to metric units made in this manner:

1 oz/28 g	9 oz/255 g
2 oz/57 g	10 oz/283 g
3 oz/85 g	11 oz/312 g
4 oz/113 g	12 oz/340 g
5 oz/142 g	13 oz/369 g
6 oz/170 g	14 oz/397 g
7 oz/198 g	15 oz/425 g
8 oz/227 g	16 oz/454 g

4 fl oz/114 ml
6 fl oz/170 ml
8 fl oz/227 ml
9 fl oz/256 ml
12 fl oz/341 ml
16 fl oz/455 ml
20 fl oz/(= 1 pint)/568 ml
24 fl oz/682 ml
26 fl oz/739 ml
28 fl oz/796 ml
32 fl oz/909 ml
40 fl oz/(= 1 quart)/1.14 litres
64 fl oz/1.82 litres
3 quarts/3.41 litres
1 gallon/4.55 litres

1 lb/454 g
1½ lb/680 g
2 lb/907 g
3 lb/1.36 kg
5 lb/2.27 kg
10 lb/4.54 kg
20 lb/9.07 kg
50 lb/22.7 kg

½ inch/1.27 cm } these are exact
1 inch/2.54 cm } conversions
4 inch/10 cm
6 inch/15 cm
12 inch/30 cm
36 inch/91 cm
4 ft/1.22 m
6 ft/1.83 m
8 ft/2.44 m

Metric packages

As the metrication program gains momentum, more packages will be sold in round metric units. There is some disagreement over what is a round quantity. This is aptly illustrated in Canadian coinage and notes. The progression of notes ($1, $2, $5, $10, $20) follows the international set of preferred numbers — 1, 2, 5, 10, 20, 50, 100, 200, 500, etc., while the coinage includes the quarter rather than a 20¢ coin. This exposes a great shortcoming of the decimal system, namely, that it is not possible to divide by 2 and then by 2 again from a base of 10 and still retain whole numbers. Should the packager go for say, a range of

100 g, 200 g, and 500 g for his product—or for 125 g, 250 g, 500 g? The latter seems to find greater favour with European consumers and it is likely that multiples of 25 will be considered rounder than multiples of 20. If the product is free of statutory size restrictions, the ultimate choice of the range of sizes depends on the type of product, how it is used, the present sizes, and the capabilities of the packaging machines. A product sold at present in quantities of ½ lb, 1 lb, and 2 lb would be better changed to 250 g, 500 g, and 1 kg than to 200 g, 500 g, and 1 kg. Some other product at present sold in 2 oz, 4 oz, and 8 oz might be better at 50 g, 100 g, and 200 g. Some typical ranges and their possible metric equivalents are given below:—

Present	Possible Metric
½ lb, 1 lb, 2 lb	250 g, 500 g, 1 kg
2 oz, 4 oz, 8 oz	50 g, 100 g, 200 g
1 lb, 2 lb, 3 lb	500 g, 1 kg, 1.5 kg
1 pint, 1 quart, 3 quarts	500 ml, 1 litre, 4 litres

The consumer is concerned not only that a round value is chosen, but also that the relationships between the various sizes in the range are in a simple ratio. In some of the examples above roundness is sacrificed to the simplification of this relationship. It is also desirable for all brands of a product or product group to be packed in the same series of weights. There are powers in the Consumer Packaging and Labelling Act to enforce this if the proliferation of sizes is considered to be likely to confuse or mislead consumers. Internationally, a basic agreement was reached in 1970 in Europe for a sequence of standard weights for prepackaged foods. This is 25 g, 50 g, 125 g, 250 g, 500 g, 1 kg and 2 kg, with 375 g, 750 g, and 1.5 kg included temporarily.

Dual labelling: after metrication

When packages are made up in metric quantities, there may be exemptions from the statutory necessity for dual labelling but some packagers may wish to use both Canadian and metric units until consumers become completely familiar with the metric system.

Examples of these conversions are:

25 g/0.88 oz
50 g/1.76 oz
100 g/3.53 oz
125 g/4.40 oz
250 g/8.82 oz
500 g/17.6 oz
1 kg/2.20 lb
275 ml/9.68 fl oz
500 ml/17.6 fl oz
750 ml/26.4 fl oz
1 litre/1.75 pints
1 mm/0.039 in
1 cm/0.39 in
10 cm/3.9 in
50 cm/19.7 in
1 m/39.4 in
or
1 m/3.28 ft

Again, there is a maximum of 3 figures excluding any initial zeros. There is always a zero before the

decimal point if the quantity is less than one. The Consumer Packaging and Labelling Regulations may exempt packages labelled solely in metric units from the dual labelling requirements.

Pseudo-metrication

There is a fallacy that "going metric" means that everything should be in multiples of 10. There is no sense in, for example, packing eggs in 10's merely for the sake of change when dozens are perfectly satisfactory. A few years ago British florists reduced the number of daffodils in a bunch from 12 to 10 and claimed that this was metrication. It was significant that the price of a bunch remained much the same. Another (unsubstantiated) example of British pseudo-metrication was the furniture manufacturer who announced that his new (metric) range of chairs would have five legs. The decision whether to pack an item in cases of 10 instead of 12, or 100 instead of 144 has nothing to do with metrication. In some situations it may be advantageous to make the case weight a decimal multiple of the item weight; in others the facility of being able to pack 3x4 or 6x2 may be more important.

Costs

It is undeniable that metrication will cost something to every firm. But the conclusion of almost all firms that have already changed is that the actual costs are less than the estimated — which is in itself something rather rare. The reason seems to be that the costs of replacing machines or retooling can be fairly accurately measured, but the increase in productivity that results from metrication is harder to assess. The savings from inventory reductions are also frequently ignored in cost estimates. Frequent changes in package size and design already take place in many product lines and the change to a metric size might well be undertaken at the same time as one of these. The cost in this case would be minimal.

In an earlier paragraph the advantages of planning ahead were cited. The cost of not going metric increases with delays. On a country-wide basis it is estimated that the overall cost goes up by 7 per cent for each year metrication is delayed — and the continuing annual cost to the United States of staying on the traditional system is estimated to amount to some $600 million in lost exports. Discussion should not emphasize the cost of going metric, but the cost of not going metric.

Consumer and
Corporate Affairs

Consommation et
Corporations